Separating the Oil from the Water

NSWCCD Provides In-Service Engineering for Carriers & Other Large Ships

The Naval Surface Warfare Center, Carderock Division (NSWCCD) provides the full spectrum of expertise and facilities necessary to evaluate commercial environmental technologies and systems as well as design and engineer these systems when commercial alternatives are not readily available. One recent example of this work is the development and evaluation of Oil Water Separator (OWS) and shipboard Oil Pollution Abatement (OPA) system improvements for aircraft carriers and other large platform ships.

In February 2002, representatives from the Fleet, Naval Sea Systems Command (NAVSEA), NSWCCD and the Chief of Naval Operations (CNO) Environmental Readiness Division (N45) met at the NSWCCD Philadelphia offices to develop a plan of action to address problems with ship OPA and OWS systems. During this meeting, N45 tasked NAVSEA (05M4) to develop long-term solutions and to conduct shipboard demonstrations of the OPA and OWS improvements that were developed as a result of NAVSEA's recently completed Oil Pollution Abatement Repair and Training (OPART) Program. These demonstrations were to target system improvements that addressed the reliability, maintainability and operability of the widely used Fleet 10 gallon per minute (gpm) OWS and OPA systems. Additionally, NAVSEA was tasked to develop and demonstrate long-term solutions for the high flow OWS systems. Of particular concern were the OWS and OPA systems that had recently been installed on aircraft carriers, amphibious assault ships and other large platform hulls.

For the past seven years, high capacity (50 gpm or more) OWSs had been installed on the Fleet's larger platform ships, such as amphibious assault ships (LHAs and LHDs), and conventional and nuclear aircraft carriers (CVs and CVNs). These systems were integrated with pre-existing OPA systems using guidelines from previously installed surface combatant OPA installations. However, tank and piping configurations onboard large hull classes can differ significantly and present unique integration problems.

Numerous design, integration, operational, reliability, and maintenance issues associated with this higher capacity OWS had been identified and documented by NSWCCD Philadelphia under the NAVSEA OPART Program. These systems, known as the C-50 and C50/RF01 OWSs, have also shown that many OPA system and subsystem designs that appear viable on paper are problematic when installed and operated on ships.

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VS-50 Oil Water Separator Test Site in NSWCCD Philadelphia.
Photos by Steve Hopko

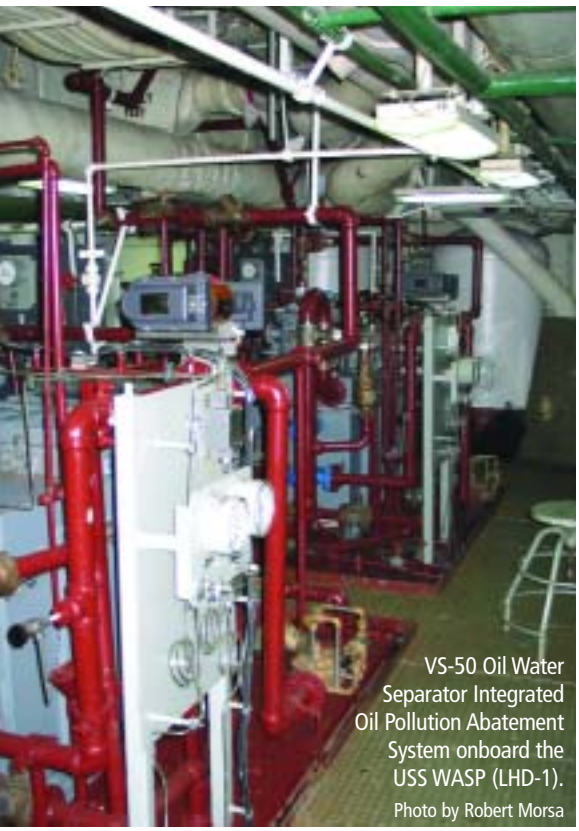
The Basics About NSWCCD's Technical Capability

NSWCCD's systems must be military mission compatible, efficient and cost effective to minimize waste generation, eliminate the use of harmful chemical compounds, and destroy or appropriately manage wastes on board ship for disposal ashore or overboard in accordance with applicable environmental regulations. These efforts support all Navy ships, marine craft and vehicles and related shore activities for any ship-to-shore interface issues or concerns.

This technical capability was established to provide systems and processes that meet the unique requirements of the warship environment (e.g. space, weight, stealth, noise, shock, logistics, manning, etc.) while still complying with the high environmental standards set forth in domestic and foreign laws and regulations. In addition to in-house development of such systems, NSWCCD adapts and integrates the latest commercial and university developed technologies and products into environmental systems for today's ships and ships of the future. These efforts support new acquisition programs so that environmental regulations and pollution controls are considered for the design, construction, operation and eventual wrecking of the Navy vehicle or system. These efforts ensure that the Navy forces and activities can continue to train and perform their missions worldwide—without the constraints imposed by environmental laws. This includes the ability to conduct peacetime transits of foreign territorial waters, and the use of domestic and foreign port facilities.

Working closely with the NSWCCD research, development, test and evaluation community in West Bethesda, MD, NSWCCD Philadelphia provides the In-Service Engineering (ISE), test and evaluation, lifecycle management and Fleet integration engineering personnel and test laboratories to support these efforts for the Navy. The Wastewater ISE Branch and the Solid Waste, Pollution Prevention and Hazardous Materials ISE Branch, located in Philadelphia provide the logistics, equipment and systems integration engineering, test and evaluation of commercial equipment or design prototypes, shipboard systems acquisition specification development, acquisition program first article testing and shipboard/Fleet support. Primarily, these groups are responsible to support the active Fleet with their deployed Environmental Quality (EQ) systems and have been designated by NAVSEA 05M (the Technical Warrant Holder for these systems) as their technical engineering agent to provide these services to the Navy.

VS-50 Oil Water Separator Main Control Panel.
Photo by Robert Morsa



VS-50 Oil Water Separator Integrated Oil Pollution Abatement System onboard the USS WASP (LHD-1).
Photo by Robert Morsa

At the same time, the Navy was acquiring and installing a commercial-off-the-shelf oil content monitor (OCM) on large platform ships. This monitor also presented very significant reliability problems. The ships started to immediately have significant certification problems, and ultimately operational reliability problems.

The separators and OCMs had a number of components that did not hold up in the marine environment.

NSWCCD Philadelphia continued to go onboard the ships between 1997 and February 2002 to certify the installations. NSWCCD Philadelphia wanted to ensure the ships could operate the systems within the NAVSEA certification requirements. NSWCCD continued to discover problems associated with the separators and the monitors as well as the integration of that equipment with the rest of the system, including Oily Waste Holding Tanks (OWHT) and tank level indicators, receivers, and switches. The alterations put the equipment on the ship and piped it up to those systems without integrating it with the rest of the system.

Complicating the matter further was the fact that these 50 and 100 gpm separators use pumps that draw the fluid through the separator. The separator actually operated under vacuum conditions. The plates in the separators also require cleaning approximately every six months, which poses a problem for the Fleet sailor. Once the cleaning process was complete, the sailor would have to reseal the separators properly for the vacuum to work. In many cases, the OWS system gaskets were failing before the OWS was ever taken down for routine maintenance.

As a result, NAVSEA 05M4 tasked NSWCCD Philadelphia to develop and test system improvements of the recently Fleet installed 50 and 100 gpm OWSs in the laboratory in time to begin installation of these system improvements on a test ship in June 2003. The laboratory testing and system improvement developments were to be conducted at the NSWCCD Philadelphia test facilities. The OPA Test Site was designed as an integrated OPA system rather than simply an OWS installation. The test site integrates the OWS and OCM, all the control valves, and a self-cleaning strainer—all designed to reduce overall system maintenance and interface from the Fleet sailor to reduce the manning requirement. It also incorporates alternative tank level switch technology. The entire system is controlled by a programmable logic controller (PLC). The PLC essentially handles the full operation of the separator as well as the flow from the OWHTs to the separator, direct transfer of bulk oil from the OWHT to the waste oil tank and all associated valves, strainers and even the OCMs.

During July 2002, engineers from NSWCCD's Wastewater ISE Branch tested three pumps in a total of four configurations for their ability to transfer fluids from the OWHT to the OWS under variable tank and flow rate conditions. (Variable flow rate is a beneficial new design feature for these OWS systems.) This testing was part of the pump selection phase of the overall system testing. Additionally, as part of the pump selection test phase, NSWCCD engineers quantified the

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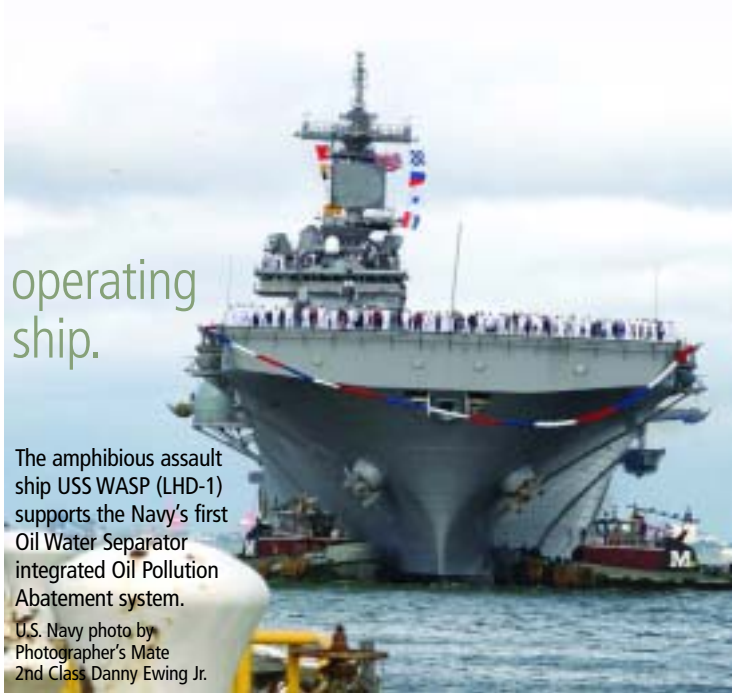

The amphibious assault ship USS WASP (LHD-1) supports the Navy's first Oil Water Separator integrated Oil Pollution Abatement system.
U.S. Navy photo by Photographer's Mate 2nd Class Danny Ewing Jr.

impact of using a particular pump upstream of the OWS by measuring and comparing the OWS performance response (OWS effluent quality or oil content) when injecting different oil concentrations and oil droplet size distributions upstream of the pump. Based on these tests, engineers determined that the OWS could be converted to a pressurized system, eliminating the need for a vacuum and the maintenance problems associated with it.

System development and testing continued while detailed designs for the installation of this system on the USS WASP (LHD-1) were being prepared. The USS WASP advanced design planning required decisions to be made for configuration and acquisition of long lead-time items even though the ship availability was not scheduled to begin until spring 2003. In September 2002, engineers conducted PLC testing, as well as interface testing with various tank level indicator technologies. The tests included proofing in the controller design and programming of all "what if" scenarios. Once the major portion of the PLC testing was completed, engineers continued to operate all other components of the system to ensure reliability goals would be met.

The system testing in the laboratory and installation and initial check out operations were completed on the USS WASP in November 2003. The ship is currently participating in the demonstration phase of this effort. NSWCCD engineers routinely visited the ship between August 2003 and January 2004 while the system was being installed to provide start-up services and crew training. In addition to these efforts, NSWCCD provided assistance to Norfolk Naval Shipyard to develop the installation drawings for the system and the system logistics package including allowance parts list and preventative maintenance system procedures and a fully comprehensive OPA system technical manual. No other ship in the U.S. Navy has a technical manual that incorporates the entire OPA system including the OWS, OCMs tank level indicators/switches and oily waste transfer system operations requirements information.

The system on the USS WASP has been operating reliably since its installation on the ship. During that time, the USS WASP has successfully completed an overseas deployment that began in February 2004. In addition to serving her primary military operations mission, the USS WASP was vital in helping NSWCCD establish the strengths and remaining weaknesses of the high capacity OPA system. This system has become known as the V-50 OWS system for its integrated design and variable speed (flow rate) capability. An NSWCCD engineer recently rode the USS WASP from Rota Spain to Norfolk, VA—the final underway period of her seven-month deployment. During that underway period, the operation of the system was evaluated and OWS influent and effluent samples were collected for later analysis.

Preliminary results from this and other OPA demonstration efforts have been favorable. In fact, this system is now being recommended by SEA 05M4 (the Technical Authority for Ship Environmental Systems) to ship program managers for installation on future navy vessels. Additionally, NAVSEA 05M4 has tasked NSWCCD to develop the necessary Ship Change Documents under the new surface Fleet Modernization Program, known as SHIPMAIN (Ship Maintenance Program) to program these alterations Fleet-wide. Under SHIPMAIN, all ship alterations are considered for development, testing and ultimate Fleet deployment to ensure the necessary resources are targeted towards the alterations the Fleet determines most important. It is believed that these alterations will be seen as necessary system improvements to reduce sailor workload and enhance operational flexibility. ⚓

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